1996 AIR QUALITY DATA SUMMARY

CITY OF NANTICOKE

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1996 AIR QUALITY DATA SUMMARY

CITY OF NANTICOKE

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Ontario Ministry of the Environment

In cooperation with:

Lake Erie Steel
Imperial Oil
Ontario Hydro
and
Environment Canada

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1. SUMMARY

Air monitoring in the industrial area of the City of Nanticoke showed that air quality was generally very good to excellent. Pollutants such as sulphur dioxide, nitrogen oxides, particulates and fluoride showed low concentrations, below Ministry objectives. Three types of pollutants were measured at higher levels. These were:

1/ Sulphur odours near Lake Erie Steel in Nanticoke Village. These were the result primarily of slag quenching operations and coke oven related operations at LES. The company instituted operational changes at its blast furnace facility in 1995 and lengthened its slag pits, all allowing for increased air cooling of slag, and concentrations improved correspondingly in 1995/96, following a record year in 1994.

2/ Organic semi-volatile hydrocarbons known as polycyclic aromatic hydrocarbons near Stelco in Nanticoke Village were elevated and sometimes above the daily objective of the one compound with a guideline - benzo(a)pyrene. However, concentrations were almost 40% lower than in 1994. Similarly, benzene levels in Nanticoke Village were reduced by about 30-50% since 1993. The improvements were likely due to the installation of an odour control system at the Stelco coke oven plant.

3/ Ground level ozone concentrations arising from long range transport of precursor pollutants from the United States during the summer. These levels occur across Southern Ontario and are sometimes accompanied by fine inhalable particulates which can exceed a newly adopted interim standard. This smog mixture is damaging both to agricultural crops and human health. In Ontario, various programs and regulations have been introduced to reduce industrial and automotive emissions. The programs have set a target year of 2015 by which time guidelines should be met.

The other two major industries in the area, Imperial Oil and Ontario Hydro's Nanticoke Generating Station showed mostly negligible ground level effects. Ontario Hydro's main emissions - sulphur dioxide and oxides of nitrogen, met all objectives out of over 60,000 monitoring hours. Imperial Oil emissions also met all ambient guidelines.

2. INTRODUCTION

The Nanticoke Environmental Management Program (NEMP) was formed in 1978 to co-ordinate a study of the background air quality and subsequent impact of industrial development on air quality in the area surrounding Nanticoke. NEMP was sponsored jointly by the Federal and Ontario Governments, Ontario Hydro, Lake Erie Steel and Imperial Oil. Beginning in 1984, the West Central Region of the Ontario Ministry of Environment and Energy assumed responsibility for network operations from the Air Resources Branch at MOE.

In mid - 1985, NEMP and a similar group concerned with water quality were amalgamated into one organization called the Nanticoke Environmental Committee (NEC). A private contractor funded by Imperial Oil and Lake Erie Steel provided one technician to assist in maintaining the air monitoring network. As of 1992, NEC concentrated solely on air quality and the air monitoring network. Water discharge issues are addressed by the MISA program of the MOEE, with each company meeting industry specific requirements.

The Nanticoke Environmental Committee consists of environmental personnel from the three industries and representatives from the MOEE West Central Region and Environment Canada. The committee meets approximately six times per year and holds an annual public meeting in November.

NEC manages an air monitoring program in Nanticoke to determine whether air quality meets standards and also to measure any impact of the industrial d[illegible]ment on the local air. Contaminants which may enter the area from outside sources are also identified.

The three main industries which have located in Nanticoke are Ontario Hydro's Thermal Generating Station, Imperial Oil's oil refinery and Lake Erie Steel's (LES) basic steel plant. In addition, several smaller industries have located in the Stelco Industrial Park, north of LES.

NEC has undertaken to measure the ambient air concentrations of those compounds or substances that are regulated under the Provincial and Federal Environmental Protection Acts, and that could be a result of the Nanticoke industrial activities. The air quality criteria are set for the protection of human health and well being as well as to protect vegetation, animal life and property.

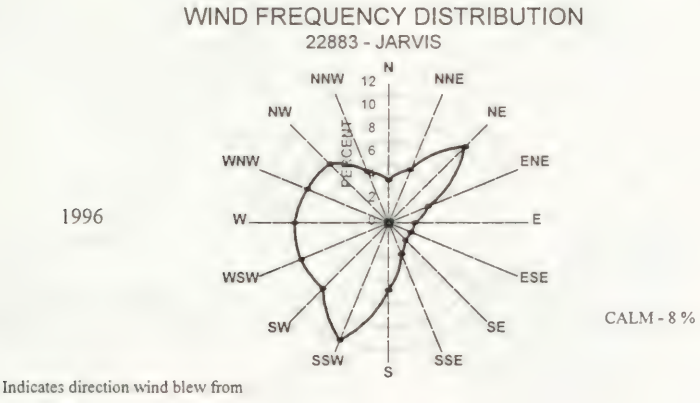
3. MONITORING NETWORK

Monitoring stations have been located to take into account predominant wind patterns and source locations as well as to try to differentiate between industrial and other contributions.

A map of the 1996 network is shown in Figure 1a with a closeup in Figure 1b, and the pollutants measured at each location are given in Table 1. Wind data (speed and direction) were measured at Long Point, near Jarvis and in Nanticoke Village. Figure 2 displays the wind frequency distribution measured at Jarvis. Winds from the southwest, west and northeast sectors tend to predominate.

FIGURE 2

1996



In addition to the NEC monitoring network, Ontario Hydro has operated its own network of sulphur dioxide analyzers since 1970. These data are also referred to in this report.

Some of the monitoring equipment in the network has also been provided by Environment Canada under the National Air Pollution Surveillance (NAPS) program. The instruments are operated and maintained by NEC and data are forwarded to Environment Canada.

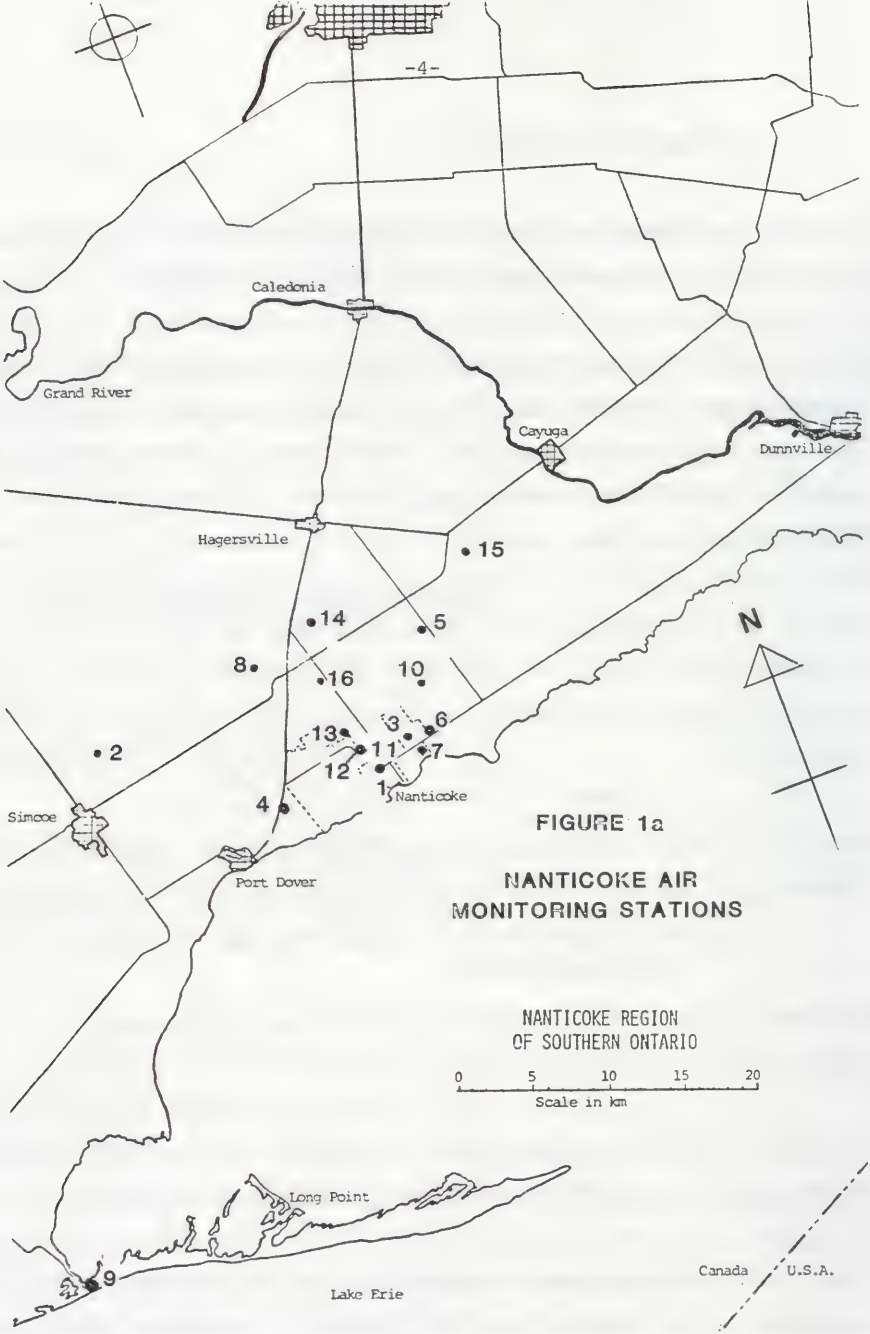


FIGURE 1a

NANTICOKE AIR
MONITORING STATIONS

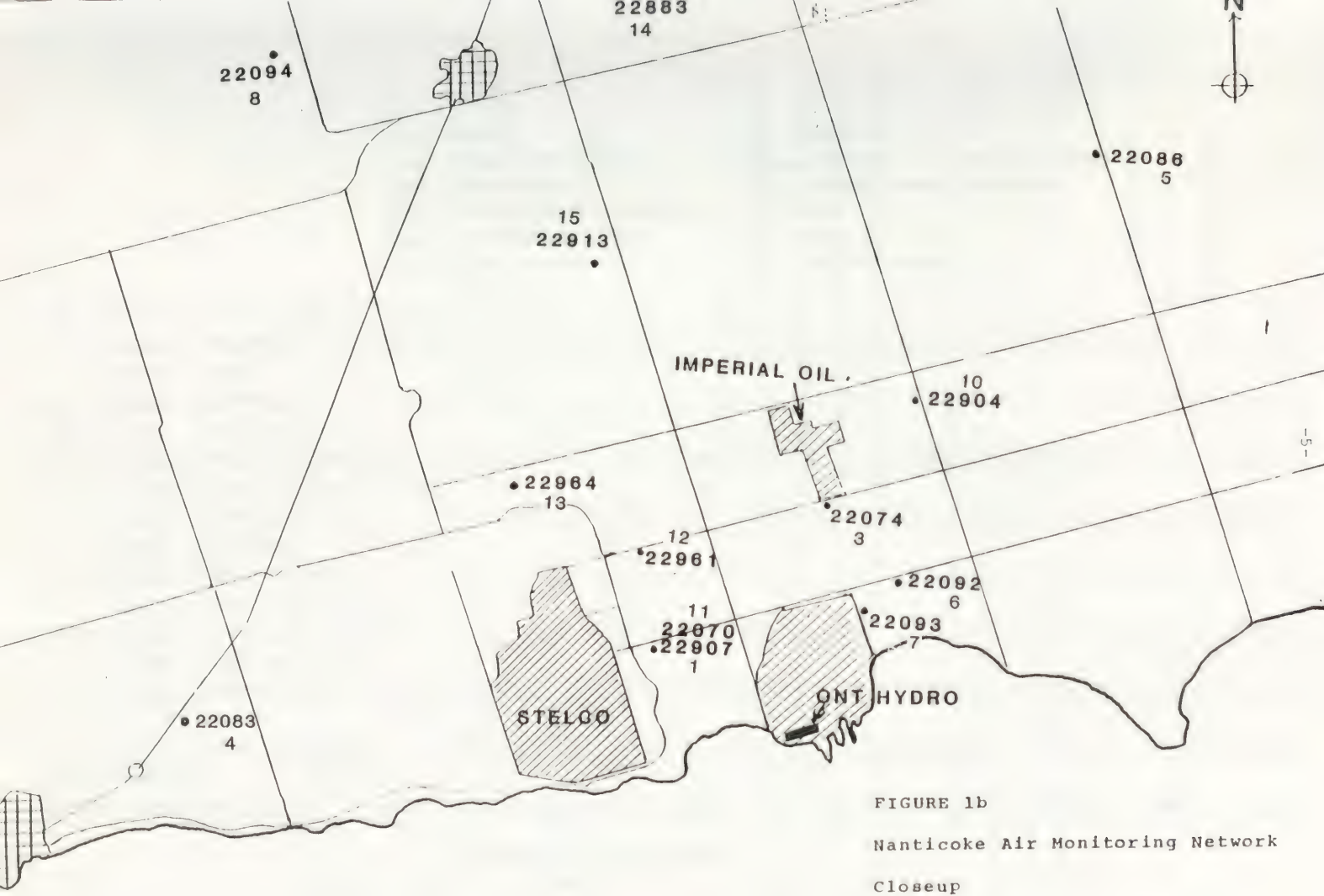


FIGURE 1b

Nanticoke Air Monitoring Network

Closeup

TABLE 1
MONITORING NETWORK

MAP REF	STATION NUMBER	LOCATION	SO2	TSP	PM10	COH	TRS	O3	NOx	DF	F	VOC	PAH	WIND	TEMP
1	22070	Nanticoke Village								X	X				
2	22071	Simcoe	X					X	X			X	X		
3	22074	Imperial Oil									X				
4	22083	Dogs Nest									X				
5	22086	Cheapside	X						X						
6	22092	Rainham/Sandusk		X						X					
7	22093	NGS [illegible]sh area								X					
8	22094	Townsend	X												
9	22901	Long Point	X					X	X					X	X
10	22904	S Walpole School	X(OH)	X	X		X					X			
11	22907	Nanticoke Village	X	X		X	X					X	X	X	
12	22961	Nanticoke North									X				
13	22964	Stelco North		X											
14	22883	Jarvis												X	X
15	22911	Balmoral	X(OH)												
16	22913	Nanticoke Rd	X(OH)												

SO2 -Sulphur Dioxide
PM10 - Inhalable Particulate
TSP - Total Suspended Particulate
COH - Soiling Index
TRS - Total Reduced Sulphur
O3 - Ozone
NOx - Nitrogen Oxides
DF - Dustfall
F - Fluoride
VOC - Volatile Organic Compounds
PAH- Polycyclic Aromatic Hydrocarbons
OH - Ont Hydro

4. ANALYSIS OF DATA

4.1 Sulphur Dioxide

Sulphur dioxide (SO_2) was measured continuously at five sites within the NEC network and at three Ontario Hydro stations in 1995. Monitoring data at all of the stations was well within the annual and daily air quality objectives of .02 and .10 ppm respectively and, the hourly standard of .25 ppm was not exceeded at any station out of about 60,000 hours of monitoring. Data are given in Table 2.

Figure 3 illustrates the historical trend of sulphur dioxide annual average concentrations of four SO_2 monitors which have operated continuously since 1976. A modest decline in concentrations can be seen over this period. The improvements in SO2 are largely due to the Countdown Acid Rain program, formulated in 1985, which required Ontario Hydro to reduce emissions across Ontario by about 55% by 1994. This goal was achieved and surpassed.

FIGURE 3

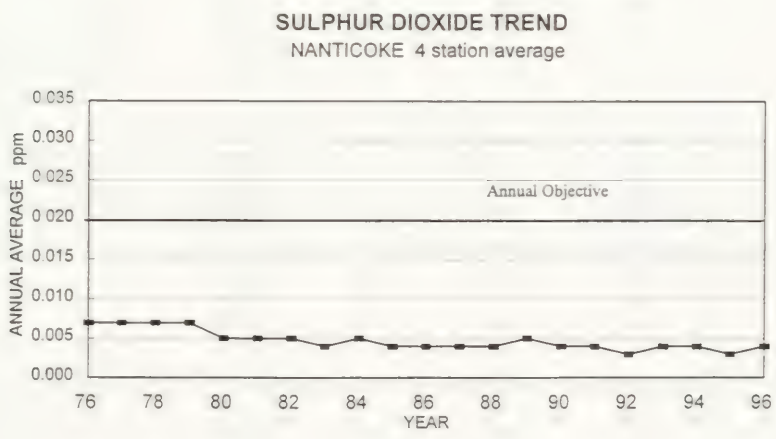


TABLE 2
SULPHUR DIOXIDE

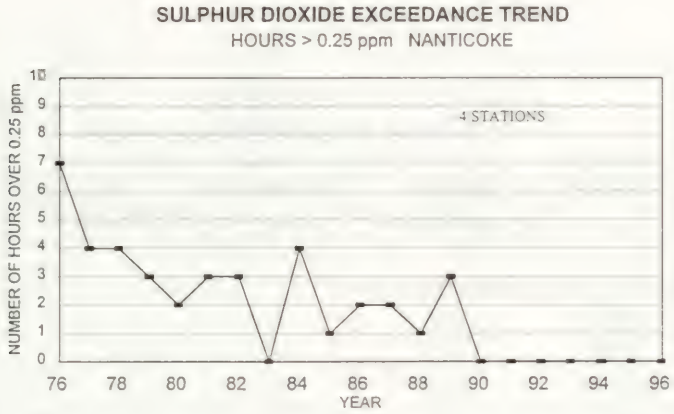
parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times > Objective	
		1 HR	24 HR	1 hr	24 hr
22071 - Simcoe					
1996	0.003	0.06	0.02	0	0
1995	0.002	0.11	0.01	0	0
1994	0.002	0.05	0.03	0	0
1993	0.003	0.09	0.03	0	0
22086 - Cheapside					
1996	0.004	0.22	0.02	0	0
1995	0.003	0.11	0.02	0	0
1994	0.005	0.13	0.03	0	0
1993	0.004	0.08	0.02	0	0
22094 - Townsend					
1996	0.003	0.05	0.02	0	0
1995	0.003	0.08	0.02	0	0
1994	0.003	0.10	0.02	0	0
1993	0.004	0.08	0.02	0	0
22901 - Long Point					
1996	0.004	0.07	0.02	0	0
1995	0.002	0.04	0.01	0	0
1994	0.003	0.06	0.02	0	0
1993	0.002	0.15	0.03	0	0
22907 - Nanticoke Village					
1996	0.006	0.22	0.02	0	0
1995	0.004	0.17	0.03	0	0
1994	0.006	0.19	0.04	0	0
1993	0.005	0.11	0.03	0	0
22911 - Balmoral(NNE16) Ontario Hydro monitor					
1996	0.003	0.08	0.01	0	0
1995	0.002	0.09	0.02	0	0
1994	0.003	0.12	0.02	0	0
1993	0.003	0.08	0.02	0	0
22913 - Nanticoke Rd(NNW08) Ontario Hydro monitor					
1996	0.002	0.15	0.02	0	0
1995	0.002	0.18	0.02	0	0
1994	0.003	0.07	0.02	0	0
1993	0.003	0.14	0.02	0	0
22916 - Walpole School S (NNE05) Ontario Hydro monitor					
1996	0.003	0.08	0.02	0	0
1995	0.003	0.06	0.01	0	0
1994	0.004	0.13	0.02	0	0
1993	0.004	0.10	0.02	0	0

Ontario Objectives: .25 ppm (1 hour)
.10 ppm (24 hour)
.02 ppm (annual)

Similarly in Figure 4, the number of hourly exceedences per year at these stations is shown. A declining trend is apparent in this graph as well. There have been no exceedances of the hourly criterion since 1989 at any station

FIGURE 4



4.2 Total Reduced Sulphur

Total Reduced Sulphur (TRS) was monitored at two locations - in Nanticoke Village and at South Walpole School on Sandusk Road. There are no general criteria for TRS but there is an hourly objective for hydrogen sulphide (H_2S), the "rotten egg" gas, of 20 ppb. The monitoring instrument measures H_2S, and other sulphur compounds.

Possible sources of these pollutants include slag quenching activities and the coke ovens/by-products plant at Lake Erie Steel (LES) and fuel oil storage tanks and a sulphur recovery operation at Imperial Oil. Apart from industrial sources, sulphur compounds can be liberated from groundwaters that have been contaminated by natural seepages or from leaking natural gas wells, known to exist in the area. LES sulphide emissions have been shown to consist primarily of H_2S and thus, comparison of TRS data to the H_2S objective, particularly within Nanticoke Village when downwind of LES, is reasonable. Imperial Oil emissions have been less well characterized but are not believed to consist totally of H_2S. Other organic sulphur compounds are probably present in their emissions and consequently levels downwind of the

TABLE 3

parts per billion

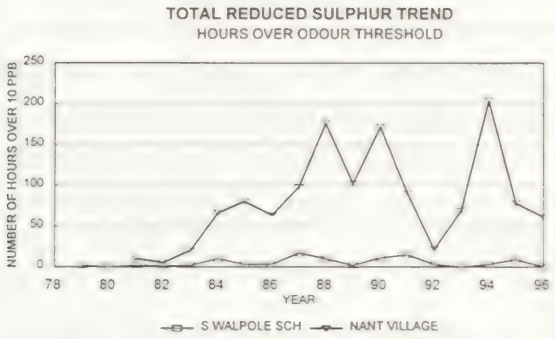
TOTAL REDUCED SULPHUR

YEAR	ANNUAL AVERAGE	MAXIMUM 1 HR	No. hours above	
			20 ppb	10 ppb
22904 - South Walpole School				
1996	0.5	9	0	0
1995	0.6	17	0	9
1994	0.6	26	1	3
1993	0.4	10	0	0
22907 - Nanticoke Village				
1996	0.9	2[illegible]	3	61
1995	1.1	65	23	88
1994	1.6	55	34	204
1993	1.1	28	2	69

Ontario Objective: 20 ppb (1 hour) - Hydrogen Sulphide

refinery cannot always be compared to the H_2S standard. The TRS data are summarized in Table 3 and trends are illustrated in Figure 5.

FIGURE 5



The South Walpole School station did not either exceed the criterion level of 20 ppb or the odour threshold of 10 ppb in 1996, as given in Table 3. This does not imply that the school was entirely TRS odour-free, as odours can be detected over very short time frames which would not be enough to generate an elevated hourly average. Nonetheless, TRS at the school was very low.

Levels recorded in Nanticoke Village close to LES improved further in 1996. There were only 3 hours above the hourly H_2S objective (20 ppb) during the year and 61 hours above the odour threshold level of 10 ppb. This follows the 1994 results, which recorded 34 hours over 20 ppb and 204 hours over 10 ppb, the most ever for this site. The improvement has been due to two changes at LES. Firstly, the blast furnace slag quench pits were lengthened, which increased the surface area of molten slag, promoting greater air cooling. Secondly, the company modified water quenching cycles at the slag pits, again promoting greater air cooling and thus reducing emissions.

The other main odour sources at LES - the coke oven plant, have also been addressed. A new gas collection system for the tar decanters and dehydrators was installed across the entire coke oven plant in 1994. The effectiveness of this system is still being studied, but improvements in hydrocarbon levels were observed in 1995 and 1996 (to be discussed in subsequent sections).

4.3 Oxides of Nitrogen

Oxides of nitrogen result from high temperature combustion sources including automobiles and industrial facilities. The most abundant oxides are nitric oxide (NO) which is largely a direct emission of fuel burning and nitrogen dioxide (NO_2) which is mostly an oxidation product once the contaminant is airborne. Thus, in the plume from the Ontario Hydro stacks, colourless NO is emitted and, as it oxidizes to brown coloured NO_2 in the atmosphere, a yellowish brown colour can appear. It had been hoped that the installation of low NO_x burners, as part of the acid rain program would remove this, but some coloration still occasionally appears. Imperial Oil boilers and various sources at LES are also emitters of these pollutants.

Objectives exist only for nitrogen dioxide and are based on odour threshold levels (hourly - .2 ppm) and health effects (24-hour - .1 ppm). Other adverse effects occurring at higher levels include vegetation damage, reduced visibility and corrosion of metals.

Data for NO_2 for three stations are summarized in Table 4. Levels in 1996 continued to be very low and well within objectives. There have never been any NO_2 exceedences measured. A combined yearly trend of NO_2 for the stations is given in Figure 6. Overall, a small trend to decreasing concentrations is apparent.

FIGURE 6

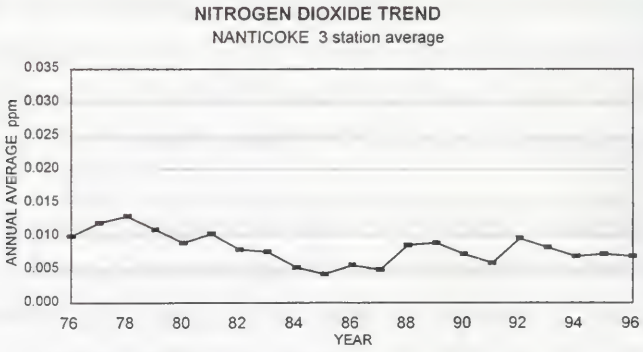


TABLE 4
NITROGEN DIOXIDE

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM		No. Times > Objective	
		1 HR	24 HR	1 hr	24 hr
22071 - Simcoe					
1996				0	0
1995	0.008	0.05	0.02	0	0
1994	0.004	0.04	0.02	0	0
1993	0.008	0.08	0.04	0	0
22086 - Cheapside					
1996	0.007	0.06	0.02	0	0
1995	0.007	0.05	0.03	0	0
1994	0.010	0.11	0.04	0	0
1993	0.012	0.06	0.03	0	0
22901 - Long Point					
1996				0	0
1995	0.007	0.07	0.04	0	0
1993	0.005	0.12	0.03	0	0
1992	0.006	0.05	0.03	0	0

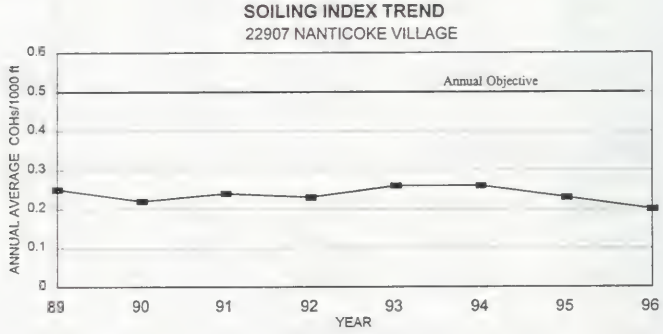
Ontario Objectives : .20 ppm (1 hour)
.10 ppm (24 hour)

4.4 Soiling Index (Coefficient of Haze)

Coefficient of haze tape samplers operate continuously and determine hourly soiling values of dust in air. Air is drawn through a filter paper trapping dust on the filter, and the optical density of the darkened spot is measured by light transmittance. The instrument takes readings before and after sample collection. The resultant light obstruction is determined and converted to a unit known as coefficient of haze. The particles sampled are very small, less than 10 microns in diameter (a micron is a millionth of a metre) and thus represent the inhalable range.

One tape sampler operates at 22907 - Nanticoke Village and the 1996 data are summarized in Table 5. The yearly average was less than half the yearly objective and the daily objective was not exceeded. Concentrations over years of sampling have been stable as shown by Figure 7.

FIGURE 7



Despite these favourable results, a special continuous particulate sampler measuring fine inhalable particles by their mass rather than light transmission was temporarily installed in 1996. It proved to be a better device to monitor dust than the COH sampler. The COH appears less able to sample particles during stronger wind speeds, which are more common in the Nanticoke area. NEC is attempting to obtain one of these particulate samplers to replace the COH in Nanticoke Village. Ontario Hydro plans to purchase four such monitors, to be used elsewhere in the NEC network.

TABLE 5
SOILING INDEX

COHs per 1000 ft

YEAR	ANNUAL AVERAGE	MAXIMUM 24 HR	No of days over 24 hour Objective
22907 - Nanticoke Village			
1996	0.20	0.7	0
1995	0.23	0.8	0
1994	0.26	0.8	0
1993	0.26	0.8	0
1992	0.23	0.7	0

Ontario Objectives: 1.0 COHs/1000 ft (24 hour)

0.50 COHs/1000 ft (1 year)

4.5 Ozone

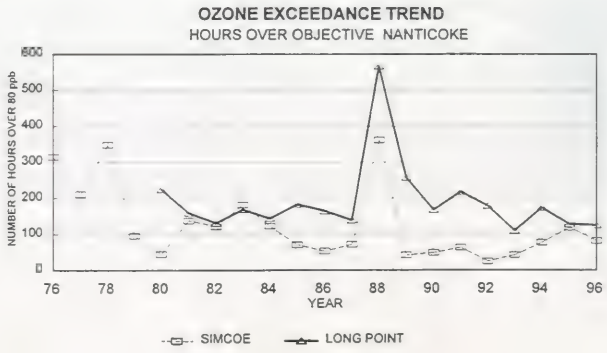
Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. The nitrogen oxides and hydrocarbons come mainly from cars and industry. Ozone (O_3) is the main oxidant chemical produced. At high altitudes, ozone filters harmful ultra-violet radiation from incoming sunlight (the "ozone layer"), but at ground level, ozone damages vegetation including tobacco and tomato crops and is a respiratory irritant. The 1-hour objective for ozone (.08 ppm) is based on vegetation effects.

Ground level ozone concentrations follow very definite annual and daily trends. Highest levels occur during the summer (May to September), and the daily maxima usually occur during mid-afternoon. Both patterns occur because ozone production increases with temperature and sunlight.

Ozone concentrations were measured at two sites and data are summarized in Table 6. In 1996, ozone levels again frequently exceeded the hourly objective in the summer as in previous years. There were 125 exceedances of the objective observed at Long Point and 82 at Simcoe. If the Air Quality Index (AQI) were in place, the stations would have recorded 976 and 1089 hours respectively in the Moderate category due to ozone alone. Elevated levels generally occurred at the same time at both stations during the summer with slightly higher concentrations measured at Long Point during southerly winds indicating that the high concentrations were imported from the United States.

The yearly trend graph of hourly exceedences at the two stations in Figure 8 indicates random fluctuations which are probably related to climatological variation. A number of measures are being taken to reduce ground level ozone, discussed below.

FIGURE 8



Ozone, hydrocarbons and oxides of nitrogen can be transported over great distances and can be augmented by local sources. It is generally believed that the ozone problem in Southern Ontario has a large component due to long range transport from the United States and thus will have to be resolved on an international and national rather than local scale.

In recognition of the seriousness of the ground-level ozone problem, the Canadian Council of Ministers of the Environment decided in 1988 to develop a management plan for the control of nitrogen oxides (NOx) and volatile organic compounds (VOC). A three phase NOx and VOC control plan was developed to resolve the ozone problem by the year 2005. A newer Ontario smog management plan challenges stakeholders to commit to reducing smog pollutants. The goal is to reduce emissions of nitrogen oxides and volatile organic compounds by 45 per cent by the year 2015. We are also challenging our U.S. neighbours to do more to cut emissions.

The Ministry is taking its own initiatives in combatting photochemical smog. To reduce NOx and VOC, the precursors of ozone, a number of new regulations are being introduced including:

-requirements for the installation of vapour recovery equipment on during gasoline distribution.
-emission limits for stationary turbines.
- requirements for restricting volatile components in gasoline during the summer.
- requirements for training of dry cleaners to minimise VOC emissions.
-the Drive Clean program (to begin in mid 1998) - a program for the inspection and maintenance of trucks and buses, and later to be extended to cars and light trucks in Toronto and Hamilton-Wentworth (initially).

Further, as an interim measure, the Ministry, in co-operation with Environment Canada, broadcasts air quality advisories for Southern Ontario related to the ozone monitoring program. When ozone levels are expected to reach 80 ppb or higher the next day, such a forecast is included in normal weather reports. The advisories currently apply to data from urban monitoring stations, but a rural Air Quality Index station is being considered for Haldimand-Norfolk by the Ministry. Haldimand-Norfolk residents should pay heed to the current advisories as ozone concentrations are usually higher there than in the urban areas designated. The public is advised to avoid strenuous exercise, and since sensitive individuals may experience respiratory symptoms, they should alter their activities accordingly. The public is encouraged to reduce their use of automobiles, to car pool, to use public transit and to avoid the use of solvents, oil

TABLE 6
OZONE

parts per million

YEAR	ANNUAL AVERAGE	MAXIMUM 1 HR	No. of Hours Over Objective
22071 - Simcoe			
1996	0.030	0.112	82
1995	0.031	0.118	119
1994	0.030	0.103	77
1993	0.028	0.097	42
22901 - Long Point			
1996	0.033	0.129	125
1995	0.031	0.121	128
1994	0.032	0.158	174
1993	0.031	0.131	110

Ontario Objective: .08 ppm(1 hour)

based paints and gasoline powered equipment such as lawn mowers.

Locally, Ontario Hydro has already taken voluntary control steps by installing low - NO_x burners at its coal burning power plants, including Nanticoke. Imperial Oil voluntarily implemented a leak detection and repair program, aimed at reducing VOC emissions.

4.6 Total Suspended Particulates and Inhalable Particulates

Total suspended particulates (TSP) in air are measured with high volume samplers which draw a known volume of air through a pre-weighed filter for a 24 hour period (midnight to midnight). The exposed filter is weighed, and the difference (weight of solids on filter) in conjunction with the known air volume sampled is used to calculate a TSP concentration in micrograms per cubic meter. The objective for a 24 hour average is 120 ug/m^3 while the yearly geometric mean objective is 60 ug/m^3. The samplers operate once every six days.

Data from total suspended particulate measurements at four locations are summarized in Table 7. The yearly objective of 60 ug/m^3 was not exceeded at any of the stations, and the daily objective of 120 ug/m^3 was exceeded only once at 22092-Rainham Rd. The carbon content of this sample was elevated .suggesting either coal dust or soots from Ontario Hydro contributed.

A total of four hi-vol stations have been operating continuously since 1984 in the Nanticoke area, and the combined yearly trend of these stations is shown in Figure 9. Levels have been low compared to the objective.

FIGURE 9

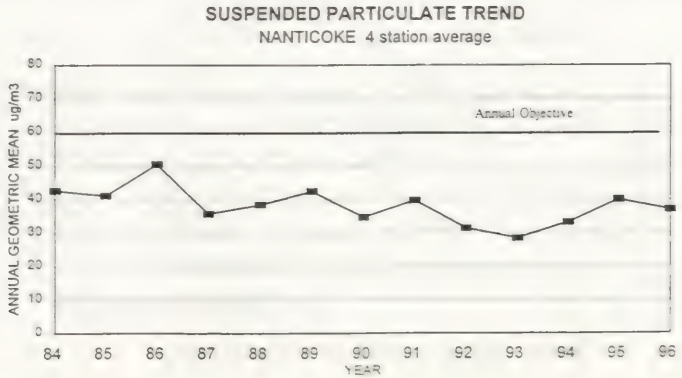


TABLE 7
SUSPENDED PARTICULATES (TSP)

micrograms per cubic metre

YEAR	GEOMETRIC MEAN	MAXIMUM 24 HR	% OF SAMPLES OVER DAILY OBJECTIVE
22092 - Rainham/Sandusk			
1996	32	130	2
1995	36	101	0
1994	30	78	0
1993	25	130	2
22904 - South Walpole School			
1996	33	86	0
1995	39	91	0
1994	29	62	0
1993	20	68	0
22907 - Nanticoke Village			
1996	50	118	0
1995	51	161	6
1994	48	113	0
1993	42	140	2
22964 - Stelco North			
1996	32	95	0
1995	34	121	2
1994	28	81	0
1993	27	80	0
INHALABLE PARTICULATES (PM10)			
22304 - South Walpole School			
1996	12	68	2
1995	14	43	0
1994	15	41	0
1993	15	69	5

Continuous PM10 - Special Survey (Feb. 21-Nov. 1,1996)

22907 - Nanticoke Village

	Average	Max 24 hr	Days over Objective
1996	23	75	12

Ontario Objectives (TSP): 120 (24 hour)
60 (annual geo. mean)

Ontario Objective (PM10): 50 (24 hour)

Figure 10 shows the trend of suspended particulate at station 22907 in Nanticoke Village near LES. Concentrations can been seen to be gradually decreasing, similar to the overall network trend.

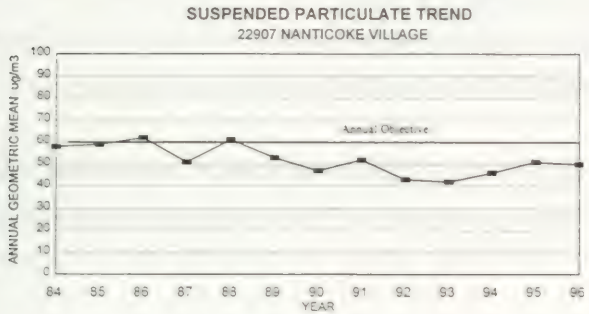


FIGURE 10

Figure 11 shows the trend of suspended particulate and dustfall at station 22092 near Ontario Hydro. A control program at their ash lagoon area introduced years ago and maintained to the present has resulted in acceptable particulate levels near this facility, generally well below objectives. Ontario Hydro has also converted to a dry ash system which has enabled them to sell most of their ash. This has further reduced the dust emission potential of the ash lagoon area. As noted however, one TSP exceedance was noted at station 22092.

FIGURE 11

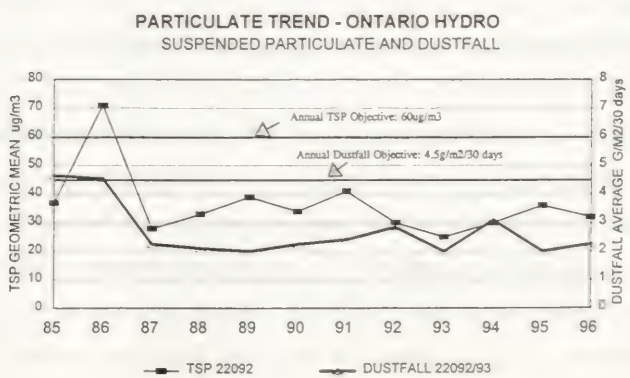


Table 7 refers to inhalable particulate measurements at 22904 - Walpole School. Inhalable particulate is defined as particles less than 10 microns in diameter. A micron is one millionth of a metre. These particles can penetrate into the human respiratory system, and research has shown a correlation of health effects and high concentrations of these particles which are commonly referred to as PM10.

The measurement methodology is similar to that for suspended particulate, except the standard hivol sampler is outfitted with a size fractioning head, which permits sampling only of particles less than 10 microns. An interim 24 hour standard of 50 ug/m3 was adopted in 1997.

The concentrations at Walpole School have been low and constant since monitoring began in 1992 and comprise about 30- 35% of total suspended particles. These levels are much less than measured in urban areas.

The interim standard was exceeded once on August 7, a high ozone day. The sulphate component (the main portion of long range transported particles) comprised over 60% of this sample. PM10/sulphate/ozone was elevated across Southern Ontario on this day. Most of this pollution originated in the United States.

From February 21 to Nov 1,1996, a continuous PM10 sampler was run at the Nanticoke Village station in response to black fallout concerns expressed by residents. Data are summarized in Table 7. The daily objective of 50 ug/m3 was exceeded on 12 days and concentrations averaged 23 ug/m3, which is about similar to downtown urban areas, but higher than the PM10 levels at Walpole School. Concentrations peaked in the summer months over the course of the survey suggesting fugitive dust sources from LES. Lower concentrations at the end of the survey coincided with a reduction in fallout complaints.

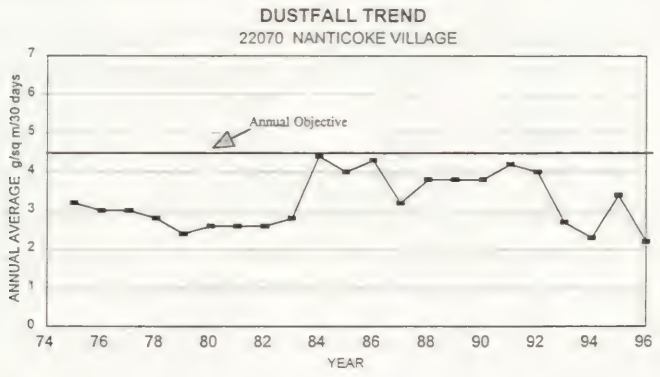
Inhalable particulates are becoming one of the most important pollutants to monitor, as scientific research has shown them to be among the leading pollutants causing adverse health impacts. Special continuous particulate samplers measuring fine inhalable particles by their mass are now being introduced across Ontario and North America. NEC is attempting to obtain one of these particulate samplers to replace the COH tape sampler in Nanticoke Village. Ontario Hydro plans to purchase four such monitors, to be used elsewhere in the NEC network. Environment Canada has provided one sampler at the Simcoe station in 1997.

4.7 Dustfall

Dustfall is that material which settles out of the atmosphere by gravity. It is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/m^2/30 days. The measurement is imprecise and effects are restricted to relatively local areas, however, it is the best method for measuring this heavy material. Dustfall objectives are based on nuisance effects and are 7.0 grams/m^2/30 days (monthly) and 4.5 grams/m^2/30 days (yearly average). Since dustfall is comprised solely of non-inhalable, large particles, it is not a health related parameter.

Dustfall was measured within Nanticoke Village in 1996, (station 22070) and data are given in Table 8. Concentrations were low and the monthly objective was not exceeded. The annual trend at this station since 1975 is given in Figure 12 and shows a decline in the 1990s.

FIGURE 12



Two dustfall jars were located near the Ontario Hydro flyash lagoon area. The monthly objective was exceeded once at 22092 on Rainham Rd. Much of this sample was composed of biological material, but a large fraction, up to 40% was coal dust. Thus, occasional dust emissions from Ontario Hydro remain.

However,the control program at Ontario Hydro referred to earlier has been mostly successful in reducing windblown flyash emissions, previously shown by the trend graph in Figure 11.

TABLE 8
DUSTFALL

grams per square metre per 30 days

YEAR	ANNUAL AVERAGE	MAXIMUM 1 MO.	NO. OF MONTHS OVER OBJECTIVE
22092 - Rainham/Sandusk			
1996	2.7	13.8	1
1995	1.9	4.3	0
1994	3.2	6.9	0
1993	2.4	8.2	1
22093 - NGS Flyash Area			
1996	1.8	4.2	0
1995	2.1	4.4	0
1994	3.0	6.6	0
1993	1.6	3.7	0
22907 - Nanticoke Village			
1996	2.2	4.4	0
1995	3.4	23.0	1
1994	2.3	5.9	0
1993	2.7	5.7	0

Ontario Objectives : 7.0 (1 month)
4.5 (annual mean)

4.8 Fluoridation

This measurement is a relatively simple assessment used to determine quantities of fluoride compounds in the ambient air. A lime coated paper is exposed to the atmosphere for approximately 30 days and chemically analyzed for fluoride. The fluoride objectives are based on vegetation damage and for this reason, the objective is more stringent during the growing season. For the months of April to October, it is 40 micrograms/100 cm^2/30 days while for the remainder of the year it is 80. A possible source of this contaminant is LES's basic oxygen furnace, although gas scrubbing removes most of the emissions.

Four stations surrounding LES property monitored fluoride and 1996 data are given in Table 9 together with a trend graph in Figure 13. The fluoride objectives were exceeded during two months in Nanticoke Village (22070). This monitor was relocated in 1994 from an old established site about 500 metres south and this has resulted in higher readings since the Village site is more frequently downwind of the main steel mill sources. The observed levels are not cause for alarm, but trends will be monitored. The increase noted in the graph for 1994/95 is due mainly to the station relocation, ie. the readings would have been similar in previous years if measured at the new site.

FIGURE 13

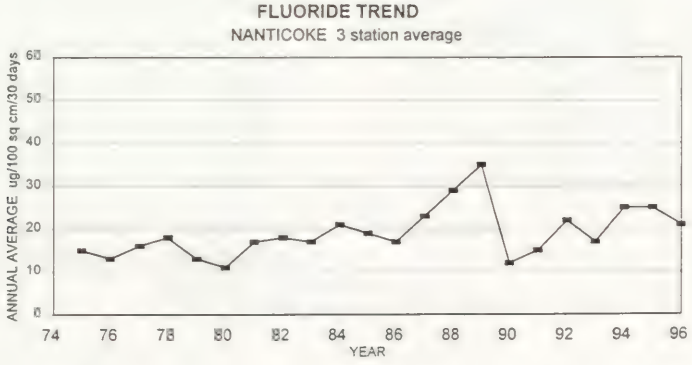


TABLE 9
FLUORIDATION RATE

micrograms / 100 square cm / 30 days

YEAR	ANNUAL AVERAGE	MAXIMUM 1 MO.	NO. OF MONTHS OVER OBJECTIVE
22057/70 - Nanticoke Village			
1996	46	167	2
1995	44	62	4
1994	45*	106	3
1993	21	59	0
22074 - Imperial Oil			
1996	11	31	0
1995	17	25	0
1994	18	25	0
1993	16	42	0
22083 - Dogs Nest			
1996	6	16	0
1995	13	31	0
1994	13	22	0
1993	13	34	0
22961 - Nanticoke North			
1996	13	26	0
1995	22	35	0
1994	31	42	1
1993	27	39	0

Ontario Objectives: 40 ug/100cm2/30 d (1 month) : Apr-Oct
80 ug/100cm2/30 d (1 month) : Nov-Mar

** 22057 moved to 22070 in March 1994*

4.9 Volatile Organic Compounds (VOC)

Airborne organic chemicals are of concern due to their complexity and variety of potential toxic effects, including carcinogenicity. Routine monitoring of these compounds in Nanticoke was undertaken at three locations.

The monitoring involves drawing a measured volume of air into glass cartridges containing an adsorbent material. Samples were run for 24 hours (midnight to midnight) every 12th day followed by analysis by gas chromatography for 32 chemicals at the MOEE laboratory. One site at Simcoe, was run by Environment Canada techniques, whereby 24 hour samples were collected in evacuated canisters every 6th day and analyzed for 151 chemicals.

Lake Erie Steel and Imperial Oil are the main industrial sources. Ontario Hydro is not considered to be a significant source of these contaminants.

Table 10 shows that on average, there was a small difference in concentrations between the Simcoe control location and the two industry monitors. On an individual sample basis, there was a small observable effect when downwind of the steel mill, however, concentrations were well below criteria. The most notable downwind effect was that for benzene, however, average benzene levels were lower in Nanticoke Village in 1994-96 than in 1993 as shown in Figure 14. The maximum benzene reading was 10.0 ug/m3 in 1996 compared to 17.0 ug/m3 in 1993. The coke oven control system probably caused this improvement. The figure also shows that levels in Nanticoke are similar to an urban residential area on Hamilton mountain.

FIGURE 14

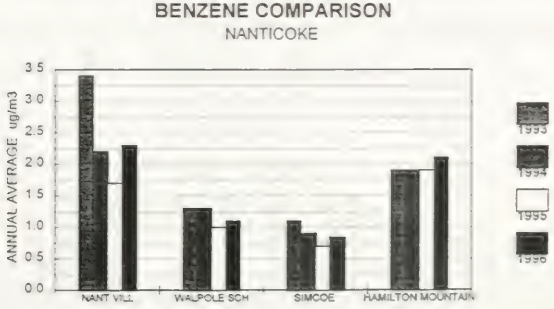


TABLE 10
VOLATILE ORGANICS (VOC) - 1996

micrograms per cubic metre

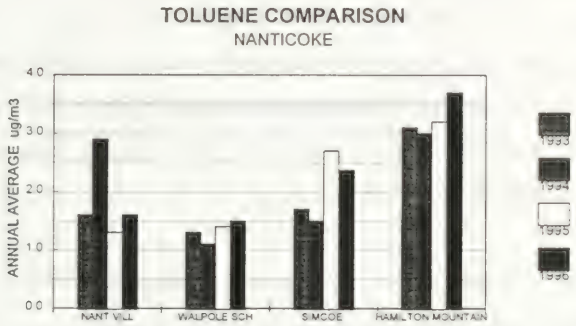
By Env Canada

		22907 Nanticoke Village					22904 Walpole School					22071 Simcoe				
	24 HR	No of	Average				Max	No of	Average				Max	No of	Average				Max
	GUIDELINE	Detects	1996	1995	1994	1993	1996	Detects	1996	1995	1994	1993	1996	Detects	1996	1995	1994	1993	1996
VOC TOTAL		25	13.1	9.2	12.1	9.9		24	11.4	7.7	9.7	6.8		48	8.3	8.2	7.8	7.4	
VINYL CHLORIDE	1	0						0						8					0.1
1,3-BUTADIENE		0			0.1			2			0.1		0.1	12	0.0	0.0	0.0		0.2
ISOPRENE		10	0.1	0.1	0.1		0.4	9	0.1	0.1	0.1		0.3	35	0.1	0.1	0.1		1.1
1,1-DICHLOROETHENE	35	18	0.4	0.1	0.1		5.4	12	0.1	0.1	0.1		0.2	15	0.0			0.0	0.1
DICHLOROMETHANE ***	1765	25	2.9	1.7	1.5	1.0	28.6	22	2.0	1.3	2.8	0.6	13.9	48	0.5	0.6	0.6	0.7	6.0
1,1-DICHLOROETHANE		0						0						11	0.0				0.0
HEXANE	12000	25	0.5	0.5	0.6	0.6	1.3	24	0.6	0.6	0.6	0.8	1.3	48	0.5	0.4	0.5	0.7	2.4
TRICHLOROMETHANE	500	14	0.1	0.1	0.1	0.2	0.1	12	0.1	0.1	0.1	0.2	0.1	48	0.1	0.1	0.1	0.1	0.1
1,2-DICHLOROETHANE	400	0				0.1		0			0.1			48	0.0	0.0	0.0	0.1	0.1
CYCLOHEXANE	100000	21	0.1	0.1	0.1	0.1	0.2	21	0.2	0.1	0.1	0.1	0.4	46	0.1	0.4	0.1	0.1	1.3
CARBON TETRACHLORIDE	600	25	0.5	0.5	0.6	0.8	0.6	24	0.5	0.5	0.6	0.8	0.6	48	0.7	0.6	0.7	0.8	0.9
BENZENE		25	2.3	1.7	2.2	3.4	10.0	24	1.1	1.0	1.3	1.3	3.1	48	0.8	0.7	0.9	1.1	2.5
TRICHLOROETHYLENE	28000	12	0.1	0.1	0.1	0.1	0.1	7	0.1	0.1	0.1	0.1	0.1	47	0.1	0.1	0.1	0.1	0.4
1,1,1-TRICHLOROETHANE	115000	24	0.5	0.7	0.9		1.0	24	0.6	0.7	0.9		0.7	48	0.7	0.8	1.3		7.4
1,2-DICHLOROPROPANE	2400	0						0						2					0.0
TOLUENE	2000	25	1.6	1.3	2.9	1.6	3.9	24	1.5	1.4	1.1	1.3	3.1	48	2.4	2.7	1.5	1.7	40.4
1,1,2-TRICHLOROETHANE		0						0						10					0.1
1,2-DIBROMOETHANE		0						0											
TETRACHLOROETHYLENE	4000	24	0.2	0.1	0.1	0.1	0.4	23	0.2	0.1	0.1	0.1	0.3	48	0.1	0.1	0.1	0.2	0.5
CHLOROBENZENE		1					1.4	1	0.1				0.1	31	0.0	0.0	0.0		0.1
ETHYLBENZENE	4000	24	0.3	0.2	0.3	0.2	0.8	24	0.2	0.2	0.2	0.2	0.5	48	0.3	0.2	0.3	0.3	1.4
M-XYLENE	2300	25	0.9	0.8	0.8	0.6	2.6	24	0.8	0.7	0.5	0.6	1.6	48	0.8	0.6	0.6	0.7	4.0
STYRENE	400	18	0.1		0.1	0.1	0.3	9	0.1		0.1	0.1	0.2	43	0.0	0.0	0.1	0.1	0.3
O-XYLENE	2300	25	0.3	0.2	0.3	0.1	0.9	24	0.3	0.2	0.2	0.1	0.7	48	0.3	0.2	0.2	0.1	1.3
1,1,2,2-TETRACHLOROETHANE		0						0						23	0.0	0.0			0.1
a-PINENE		13	0.3	0.1			1.1	9	0.1	0.1	0.1		0.7						
1,3,5-TRIMETHYLBENZENE		24	0.1	0.1	0.1		0.4	20	0.1	0.1	0.1		0.3	47	0.1	0.1	0.1		0.3
1,2,4-TRIMETHYLBENZENE	1000	24	0.3	0.2	0.3	0.1	1.1	24	0.3	0.2	0.2	0.1	0.8	48	0.3	0.2	0.2	0.1	1.1
1,3-DICHLOROBENZENE		1					1.1	1	0.1				0.1	0			0.0		
1,4-DICHLOROBENZENE		1			0.1		0.4	2					0.1	48	0.1	0.1	0.1		0.8
1,2-DICHLOROBENZENE	30500	1					0.3	1	0.1				0.1	0				0.0	
NAPHTHALENE	22 5	24	1.5	0.5	0.8	0.8	8.4	18	0.4	0.1	0.3	0.4	2.0	48	0.3	0.2	0.2	0.4	1.0

*** *Dichloromethane data subject to occasional laboratory error*

Imperial Oil's ongoing leak detection program is continuing to reduce the refinery's VOC emissions. Apart from benzene and naphthalene which are in coke oven emissions, there is little difference between the Village, Walpole School and Simcoe for all of the remaining VOC measured. Toluene can be used as an indicator for this in Figure 15, which also shows that Nanticoke levels are all less than Hamilton mountain.

FIGURE 15



4.10 Polycyclic Aromatic Hydrocarbons (PAH)

Similar to volatile organics, other semi-volatile compounds called polycyclic aromatic hydrocarbons (PAH) are a concern due to their potential toxic effects.

PAHs are a class of compounds which are the product of incomplete combustion of fuels. They are emitted from a variety of sources including coke ovens, woodstoves, motor vehicles and barbecues.. Several specific PAHs are carcinogenic including benzo(a)pyrene (BaP). A scan of 12 compounds are routinely analyzed, but only BaP has standards/guidelines, based on health effects.

Criteria for BaP are:

24 hour average - 1.1 ng/m3

1/2 hr average - 3.3 ng/m3

The smaller molecular weight PAHs exist in vapour form. The larger ones including BaP exist mostly adsorbed onto particles.

Specially outfitted high volume samplers collect PAH both on a filter and an adsorbent cartridge which lies after the filter. The samplers run for 24 hour periods every 12th day at three stations. One of these sites - Simcoe, collected only four samples in 1996, as it was just measuring rural background. Data are summarized in Table 11.

Concentrations at Nanticoke Village were much higher than average than at Walpole School or Simcoe. The BaP objective was exceeded in 4 out of 21 samples in the Village, twice at the school, and none at the Simcoe site. There was a clear downwind effect of the steel mill in the Village samples, although similar to benzene, PAH levels have decreased substantially in 1995/96 in the Village. The average total PAH figure reduced from 105 to 67 ug/m3 and the BaP objective was exceeded in 4 of 21 samples (19%) compared to 8 of 15 (53%) in 1994.

Apart from the two exceedances, readings at the school were very low. One of the exceedances at the school coincided with a higher reading in the Village, suggesting that LES was the source, and the other exceedance occurred during winds from directions not from the industries. A source such as open burning could have been responsible.

The odour control system installed at the Stelco coke ovens has lessened PAH emissions, but further abatement efforts may be required if the BaP objective is to be totally met.

TABLE 11
POLYCYCLIC AROMATIC HYDROCARBONS (PAH) - 1996

nanograms per cubic metre

	24 Hour	22907 - Nanticoke Village						22904 - Walpole School						22071 - Simcoe					
		No of	Average			Max	No. Times	No of	Average	Max	No. Times	No of	Average			Max	No. Times
	Objective	Detects	1996	1995	1994	1996	Over Obj.	Detects	1996	1996	Over Obj.	Detects	1996	1995	1994	1996	Over Obj.
PAH TOTAL		21	67.2	60.2	105.3	430.2		22	19.0	153.9		4	10.1	7.1	11.1	34.3	
PHENANTHRENE		21	35.1	19.0	46.3	183.0		22	9.7	58.5		4	7.2	4.4	6.7	21.9	
FLUORANTHENE		21	11.5	9.9	18.7	74.2		22	3.2	28.8		4	1.6	1.2	1.8	5.0	
PYRENE		21	6.5	8.1	12.7	50.0		22	1.8	17.2		4	0.7	0.6	1.1	2.1	
BENZO(A)ANTHRACENE		16	1.5	2.8	4.3	15.7		18	0.4	4.6		4	0.0	0.1	0.2	0.1	
CHRYSENE		21	2.6	4.7	5.4	26.7		21	0.8	7.5		4	0.1	0.2	0.4	0.2	
BENZO(B)FLUORANTHENE		21	3.5	6.2	6.1	35.6		21	1.1	12.1		4	0.3	0.3	0.3	0.6	
BENZO(K)FLUORANTHENE		17	1.6	2.2	2.4	21.0		18	0.5	7.0					0.2	0.4	
BENZO(A)PYRENE	1.1	14	1.5	1.4	3.4	16.2	4	15	0.5	5.8	2	4	0.0	0.1	0.2	0.1	0
INDENO(123CD)PYRENE		19	1.6	2.9	3.8	16.8		19	0.5	5.9		4	0.1	0.2	0.2	0.2	
DIBENZO(A,H)ANTHRACENE		13	0.4	0.8		4.1		8	0.2	1.3		2	0.0			0.0	
BENZO(GHI)PERYLENE		20	1.4	2.3	2.2	13.6		19	0.5	5.1		4	0.1		0.2	0.2	
ANTHANTHRENE		3		na	na	1.3		2		0.1		0		na	na		

na- not analyzed
All annual PAH Totals are consistent with above compound list

5. DISCUSSION

Overall, 1996 data in the Nanticoke area revealed that air quality was very good and reflected a relatively minor impact by the main industries. Sulphurous odours near Lake Erie Steel were one main item of concern. Control programs instituted by the company in 1995 effectively lowered emissions, but more work may be necessary.

Pollutants such as sulphur dioxide, oxides of nitrogen, fluorides and particulates showed quite low levels well within relevant objectives. Measurements of volatile organic compounds showed mostly low concentrations well within objectives near the steel mill and refinery, similar to that measured at a background control location and less than urban areas. However, a small measurable effect was observed when downwind of the steel mill, particularly for benzene in Nanticoke Village. Concentrations of benzene were substantially lower in 1995/96 than in 1993/94, due largely to the installation of an odour control system on the coke ovens.

The coke oven control system was also effective in reducing polycyclic aromatic hydrocarbons (PAH) emissions. Concentrations were down by about 40% in Nanticoke Village, although objectives were still occasionally exceeded.

Sulphur dioxide (SO_2) normally recorded low measurements throughout the network of monitors. The Nanticoke Generating Station is the largest SO_2 source in the area but its effect on the Nanticoke area was fairly minor. Out of over 60,000 hours of monitoring, none exceeded the hourly objective. There have been no such exceedances measured since 1989.

Particulate levels in the region were quite low and showed mostly acceptable concentrations, including near LES. Close to Ontario Hydro property, distinct improvements in both suspended particulates and dustfall readings have been measured and maintained for many years. A control program to control windblown flyash has been mostly successful, although single exceedances of dustfall and suspended particulate criteria were observed.

Another pollutant of major concern is ozone, a product of long range transport. Ozone again routinely exceeded objectives during the summer in Southern Ontario due mostly to emissions from the United

States. Levels measured at Long Point were among the highest recorded in the Province. Elevated ozone was sometimes accompanied by fine inhalable particulates known as PM10. An interim daily PM10 standard was exceeded once due to these long range emissions. Oxidant/PM10 control will be required on an international and national as well as on a local scale. To this end, control programs in both the U.S. and Canada are being implemented to control volatile organic compounds (VOC) and nitrogen oxides (NOx) and PM10 in order to resolve the ground level ozone problem (smog) by the year 2015. The Nanticoke based industries will be required to participate in programs as they are developed. In fact, the industries have already begun some programs, e.g. NO_x control at Hydro and VOC control at Imperial Oil and LES.